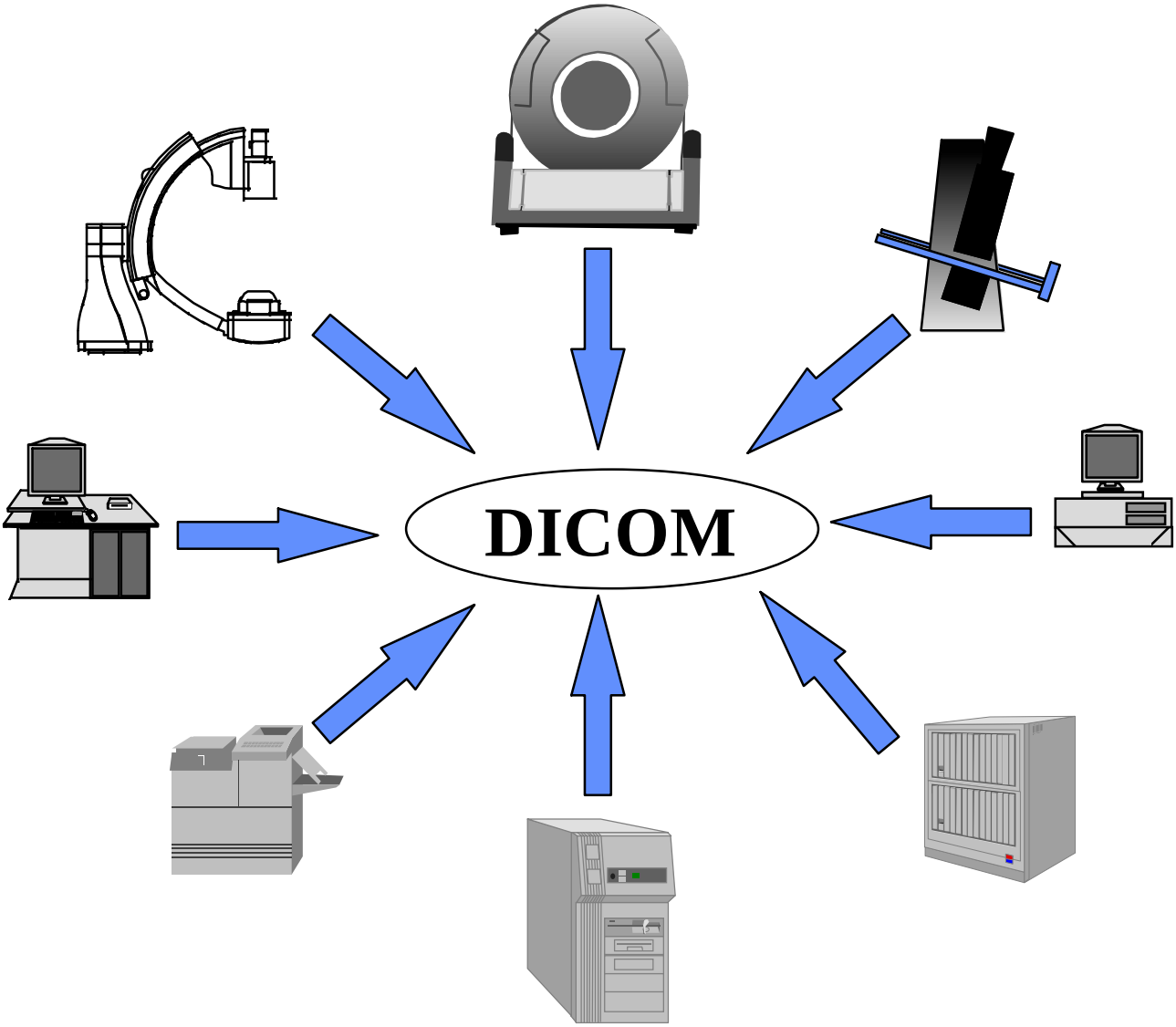
SERVICE MANUAL

How to read a DICOM Conformance Statement



PMSN Best

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LIST OF PAGES and DRAWINGS

How to read a DICOM Conformance Statement

Contents

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1. PURPOSE OF DICOM CONFORMANCE STATEMENTS

A conformance statement is a document from a manufacturer of medical devices specifying which DICOM functions are implemented in a particular system. A separate conformance statement is needed for each piece/version of equipment if supported functionality is different.

A Conformance Statement is intended for:

- potential clients,
- system integrators of medical equipment
- marketing staff interested in system functionality
- software designers implementing DICOM interfaces

A Conformance Statement is used as/for:

- **Used to Check if/what level of Connectivity is possible**

Compare list of Supported SOP Classes
Compare list of Supported Transfer Syntaxs
Compare list of Supported Attributes for each supported SOP class

Mandatory Document for all DICOM compliant systems. Request the document for all systems to connect with.

BEFORE actual installation

- Retrieve Connection and Configuration Information of the systems to connect to
- Check for Extensions and Limitations

2. DISCLAIMER

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by a Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment.
It is the user's responsibility to analyse thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.

3. HOW TO READ THIS DOCUMENT

This document describes "how to read" the contents of a DICOM Conformance Statement. In particular, chapter 5 gives an overview on the basis of paragraphs taken from the standard Conformance Statement layout of PMS-equipment. Detailed information can be found in the Conformance Statements delivered with PMS-equipment.

NOTE: Most examples are taken from the EasyVision or DSI Conformance Statement.

Document versions: Servce Manual "How to read a DICOM Conformance Statement"
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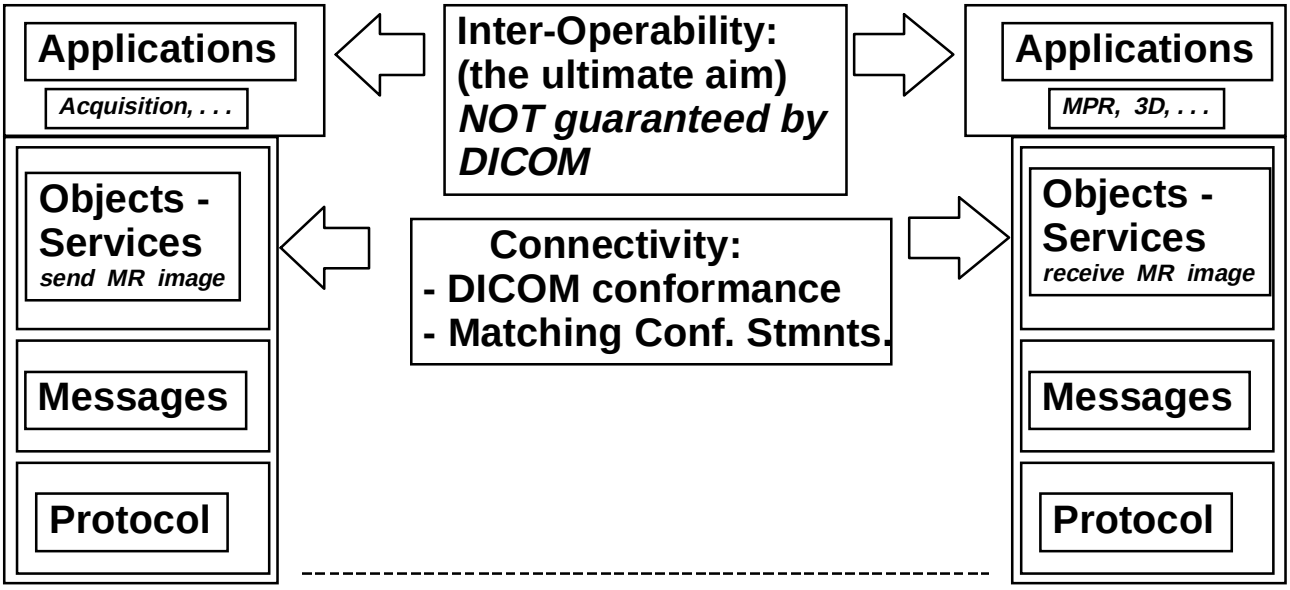
Version 97.0 see page 2.1 of manual
First issue

4. DICOM CONFORMANCE vs. INTEROPERABILITY

Conformance Statements define a level of Connectivity. This does not assure Interoperability.



DICOM knowledge is one thing, but making effectively use of it is something else. Reading DICOM conformance statements does not tell you easily which applications work. You have to supplement the conformance statement with experience and applicational knowledge. Therefore, comparing Conformance Statements is a first check; further listing/testing/checking is necessary to assure interoperability.

The following examples show that interoperability is more than connectivity:

1. Attributes not always present (e.g. optional) / allowed empty

Example:
1. private attributes: Barium on X-Ray *as last seen* as white Barium or black Barium.
2. Image number not allowed to use for slice ordering, however some manufacturers do require a value for this.
3. Patient ID value e.g. required for a lot of systems for proper storage, allowed to be empty

2. The semantics of attributes/images is not specified in enough detail in DICOM to guarantee Interoperability

Example: The way of aquisition of images is not prescribed in DICOM e.g. for Bolus Chase Reconstruction images have to be taken in a special way.

3. Applications can require certain attributes to be present, with a certain semantic interpretation of the value.

Example:
1. The EasyVision Private SOP class “3D object” can not be used within an application of another vendor.
2. Image number for ordering (incorrectly) by some vendors..
3. Patient ID needs to be filled for proper storage on media. (e.g CD-R)
4. Window Width / Window Level is not standard for all SOPs (e.g. Second Capture). Some systems need the WW/WL values always.

5. CONTENTS OF A DICOM CONFORMANCE STATEMENT

A Conformance Statement consists of the following major parts:

- an Implementation Model which describes the Application Entities in the implementation and how they relate to both local and remote Real-World Activities;
- a more detailed specification of each Application Entity, listing the SOP Classes supported and outlining the policies with which it initiates or accepts associations;
- for each Application Entity and Real-World Activity combination, a description of proposed (for Association Initiation) and acceptable (for Association Acceptance) Presentation Contexts;
- for each SOP Class related to an Abstract Syntax, a list of any SOP options supported;
- a set of communications protocols which this implementation supports;
- a description of any extensions, specializations, and publicly disclosed Privatizations in this implementation;
- a section describing DICOM related configuration details;
- a description of any implementation details which may be related to DICOM conformance or interoperability.
- For PMS modalities also a section about used attributes per SOP class.

5.1. INTRODUCTION

This section provides general information about the scope, purpose and contents of this Conformance Statement and how to use it.

EasyVision Example:

Contents:

- Scope and field of application
- Intended audience
  e.g. - (potential) clients,
  - marketing staff interested in data exchange functionality,
  - system integrators and Customer Support Engineers of medical equipment,
  - software engineers implementing DICOM interfaces.

- Contents and structure
- Used definitions, terms and abbreviations
  e.g. - DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see NEMA PS 3.3-1996.

- References
- Important notes to the reader

5.2. IMPLEMENTATION MODEL

How DICOM is implemented. A conforming implementation may choose a different number of application entities. The specified functionality shall be met regardless of the structure of the implementation. The actual number and titles of all application entities shall be specified in the vendor's conformance statement.

5.2.1. APPLICATION DATA FLOW DIAGRAM

How does the system behave? In a Conformance Statement, the relationships between Real-World Activities and Application Entities are illustrated by an Application Data Flow Diagram.
Following elements are used in this:

Application Entity:

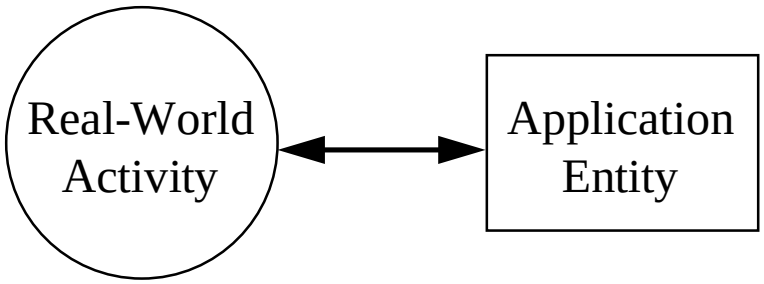
An Application (Entity) is depicted as a box within an Application Data Flow Diagram as shown below.

Real World Activity:

A Real-World Activity is depicted as a circle within an Application Data Flow Diagram as shown below.

Local Relationships:

A relationship between a local Real-World Activity and an Application Entity is depicted within an Application Data Flow Diagram by placing the local Real-World Activity to the left of the related Application Entity with a double headed arrow drawn between them as shown below.

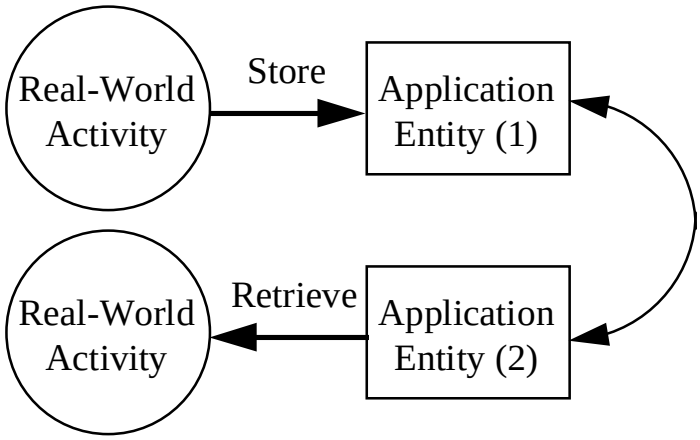


An Application Entity may be associated with multiple Real-World Activities.

AND

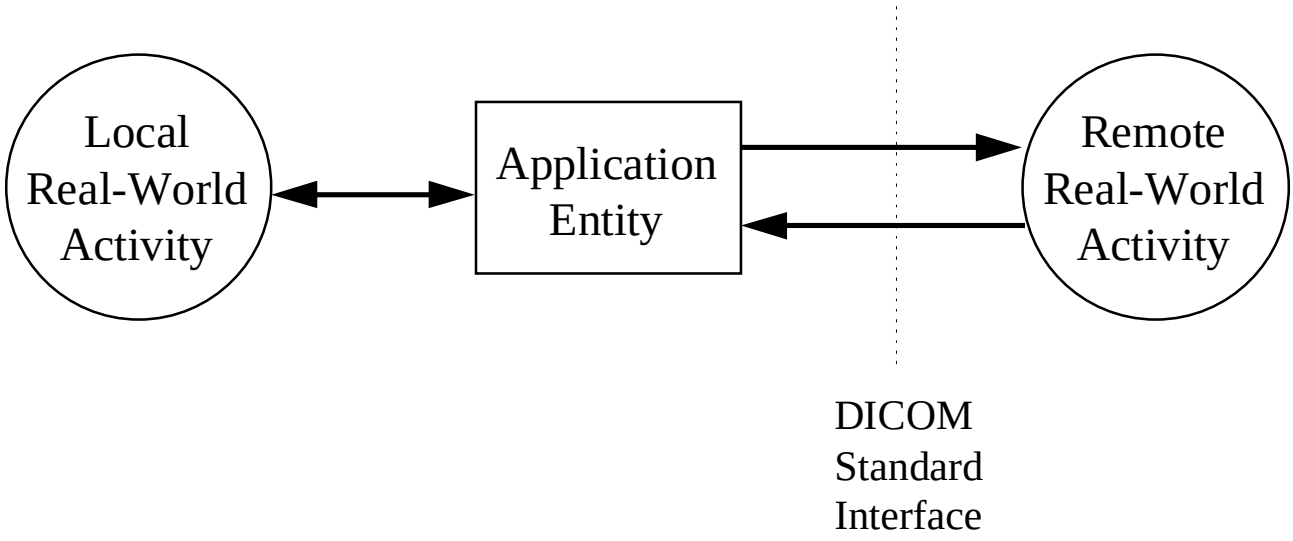
A Real-World Activity may be associated with multiple Application Entities.

Due to the DICOM Manufacturer it is also possible to use two Apllication Entity titles. The following figure presents such an implementation.



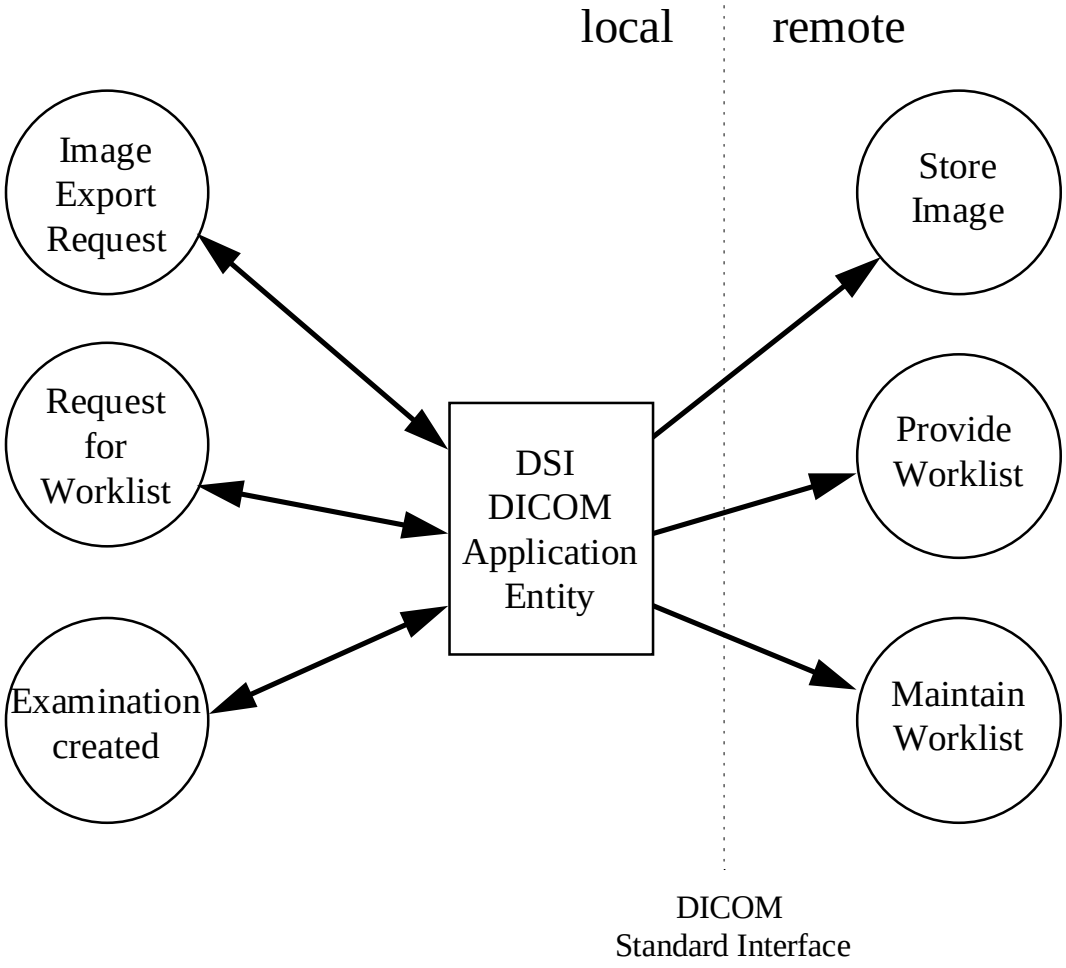
5.2.2. ASSOCIATIONS

An association between a local Application Entity and a remote Application Entity supporting a remote Real-World Activity is depicted within an Application Data Flow Diagram by placing the remote Real-World Activity to the right of the related local Application Entity with one or two arrows drawn between them as shown in the figure below. The dashed line represents the DICOM Standard Interface between the local Application Entities, and whatever remote Application Entities that handle the remote Real-World Activities. An arrow from the local Application Entity to the remote Real-World Activity indicates that an occurrence of the local Real-World Activity will cause the local Application Entity to initiate an association for the purpose of causing the remote Real-World Activity to occur. An arrow from the remote Real-World Activity to the local Application Entity indicates that the local Application Entity expects to receive an association request when the remote Real-World Activity occurs, causing the local Application Entity to perform the local Real-World Activity.



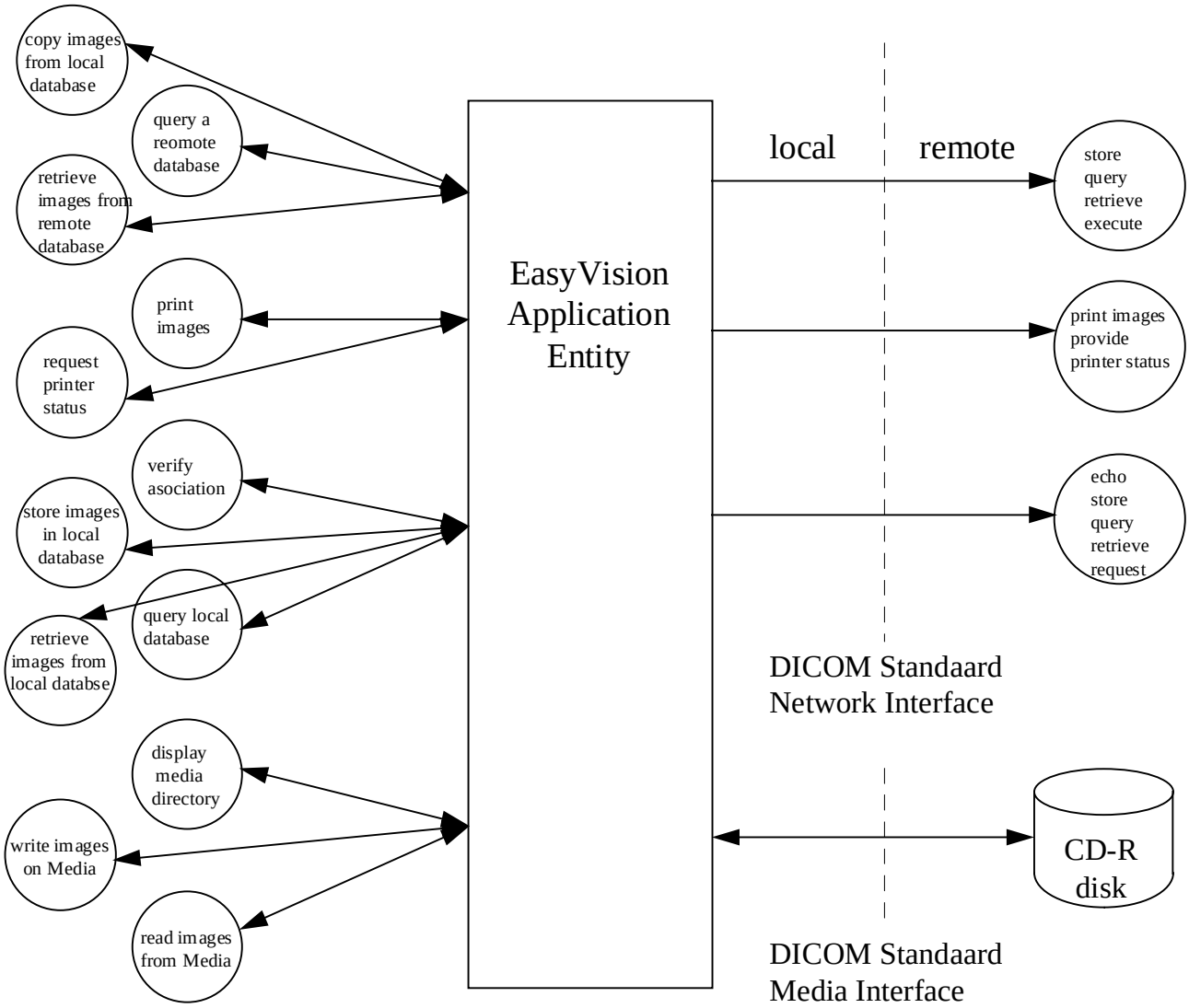
5.2.3. EXAMPLE FOR DSI

The DSI contains one Application Entity able to export DICOM images and handle Modality Worklists. The related Implementation Model is shown in the figure below.



5.2.4. EXAMPLE FOR EASYVISION

The next figure shows how the EasyVision behaves as a single application entity.



5.2.5. FUNCTIONAL DEFINITIONS OF APPLICATION ENTITIES

How do Application Entities act in terms of DICOM?

Example:

The EasyVision application entity acts as a service class user of query/retrieve and store service classes. The application acts as a service class provider of verification, query/retrieve and store service classes.

5.2.6. SEQUENCING OF REAL WORLD ACTIVITIES

Sequence of actions in the real world to be done by the user to perform a typical study.
A very easy example is given in the next 4 steps.

1. select image
2. press “copy to” button
3. select remote node
4. click ok button

EasyVision Example:

All Real-World Activities as specified in the Application Data Flow Diagram may occur independently from each other, except that the two local Print Real-World Activities are mutual exclusive: A request for the printer status is not done when a request for image printing is busy, vice versa.

DSI Example:

The Request for Worklist should be done first, before a Study Component can be created.
Then the generated images may be exported. However, export of DICOM images is also possible without the Worklist and Study Component activities.

Example for a PACS:

1 A physician orders a study for the patient at the RIS. At the time the study is ordered, the RIS sends the study and patient information to the PACS.

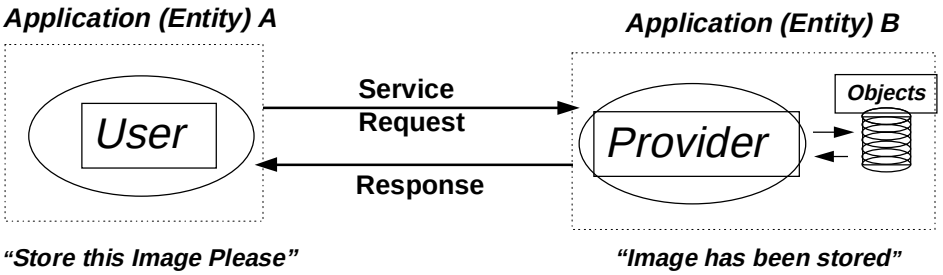
2 The patient arrives in the radiology department. A technologist obtains the patient demographics and any study order data from the patient and RIS. Using the Imaging Subsystem, the technologist either obtains the patient demographics and study data electronically from the RIS or manually enters the data. The technologist then performs the study on the patient.

3 The Imaging Subsystem uses the image data, patient demographic data and study data to build the proper DICOM objects. The Imaging Subsystem then sends the objects to the PACS.

4 The PACS system matches the DICOM objects received from the Imaging Subsystem to a patient, study, and series. The matching is performed based on the information contained in the DICOM object, and on the information in the PACS.

5.3. AE SPECIFICATIONS

An application entity (AE) is simply an abstract term that represents an entity such as a printer, workstation, software application, etc. These AEs exists in the application layer of the OSI model.
For example, if your computer is sending information to a printer, your computer represents one application entity and the printer represents another.



NOTE

A system is not limited to 1 role. It can be SCU and SCP both at the same time.

The AE Specification chapter gives detailed information about the implemented DICOM functionality of each Application Entity as a User (SCU) **and** Provider (SCP).

Examples of AE Specifications are:

- AE Network Specification
- AE Media Specification
- AE Import/Export Specification

Chapter 3 of the Conformance Statement is reserved for AE Specification.

Example: 3 AE Specifications

3.1 AE Network Specification
- Supported SOP Classes as SCU (see example 5.3.1 on page 12)
- Supported SOP Classes as SCP (see example 5.3.2 on page 13)

3.1.1 Association Establishment Policy (see example 5.3.3 on page 14)
- Number of associations
- Asynchronous Nature
- Implementation Identifying Information
- ...

3.1.2 Association Initiation Policy
- Associated Real-World Activity
- Proposed Presentation Contexts
- ...

3.1.3 Association Acceptance Policy
- Associated Real-World Activity
- Proposed Presentation Contexts
- ...

5.3.1. SUPPORTED SOP CLASSES AS SCU

EasyVision Example:

The EasyVision Application Entity provides Standard Conformance to the DICOM V3.0 SOP classes as an SCU specified the next table. The following remarks are important:

- The list of available SOP Classes out of the full list can be configured per Easy-Vision system at installation time. The SOP Classes to be used as SCU can be configured per remote station.
- In case the remote system does not support the import of a specific Image Storage SOP Class, EasyVision will convert (if configured to do so) these images and sends them via the SC Image SOP Class.
- Multi-frame Ultrasound images and Biplane XA images are not exported as such but as a sequence of separate images.
- The Private SOP Classes may be stored in image archives but are to be used in EasyVision systems only.

The EasyVision Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCU:

Supported SOP classes by the EasyVision AE as SCU

SOP class Name	UID
CR Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage (retired standard class)	1.2.840.10008.5.1.4.1.1.5
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
US Image Storage (retired standard class)	1.2.840.10008.5.1.4.1.1.6
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
XA Single-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.2
Patient Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Study Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Patient/Study Only Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
>[a] Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
>[a] Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
>[a] Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
>[a] Printer SOP Class	1.2.840.10008.5.1.1.16
3D Volume Storage (Private class)	1.3.46.670589.5.0.1
3D Object Storage (Private class)	1.3.46.670589.5.0.2
Surface Storage (Private class)	1.3.46.670589.5.0.3
Composite Object Storage (Private class)	1.3.46.670589.5.0.4
MR Cardio Profile Image Storage (Private class)	1.3.46.670589.5.0.7
MR Cardio Image Storage (Private class)	1.3.46.670589.5.0.8

a. The '>' sign indicates that the SOP Class is part of the above mentioned Meta SOP Class.

5.3.2. SUPPORTED SOP CLASSES AS SCP

EasyVision Example:

The EasyVision Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCP specified in the next table. The following remarks are important:

- The list of available SOP Classes out of the full list can be configured per Easy-Vision system at installation time. The SOP Classes to be used as SCP can be configured per remote station.
- Multi-frame Ultrasound images and Biplane XA images can be imported but are stored as a sequence of separate images.
- The Private SOP Classes may be stored in image archives but are to be used in EasyVision systems only.

The EasyVision Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCP:

Supported SOP classes by the EasyVision AE as SCP

SOP class Name	UID
Verification	1.2.840.10008.1.1
CR Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage (retired standard class)	1.2.840.10008.5.1.4.1.1.5
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
US Multi Frame Image Storage (retired standard class)	1.2.840.10008.5.1.4.1.1.3
US Multi Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
US Image Storage(retired standard class)	1.2.840.10008.5.1.4.1.1.6
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
XA Single-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.2
XA Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
Patient Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Study Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Patient/Study Only Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
3D Volume Storage (Private class)	1.3.46.670589.5.0.1
3D Object Storage (Private class)	1.3.46.670589.5.0.2
Surface Storage (Private class)	1.3.46.670589.5.0.3
Composite Object Storage (Private class)	1.3.46.670589.5.0.4
MR Cardio Profile Image Storage (Private class)	1.3.46.670589.5.0.7
MR Cardio Image Storage (Private class)	1.3.46.670589.5.0.8

5.3.3. ASSOCIATION ESTABLISHMENT POLICIES

Number of Associations: The number of simultaneous Associations which an Application Entity supports is specified in this section.

Example DSI: DSI will attempt to establish one Association at a time. DSI does not accept Associations.

Asynchronous Nature: If the implementation supports negotiation of multiple outstanding transactions, this shall be stated here, along with the maximum number of outstanding transactions supported.

Example EasyVision: EasyVision does not support asynchronous operations and will not perform asynchronous window negotiation.

Implementation Identifying Information:
Value for Implementation Class UID and Version name

Example EasyVision: The Implementation Class UID is: 1.3.46.670589.5.2.10
The implementation version name is: EV41

Associated Real-World Activity: Conditions under which an Application Entity will initiate an Association.

Example DSI: The DSI operator is able for request for export of one examination or a list of examinations to a remote system. The complete examination is transferred to the remote system. After the transfer the Association is released.

Proposed Presentation Contexts: Proposed Presentatipn Context= SOP class + Transfer Syntax combination. Each time an association is initiated, the Association Initiator proposes a number of Presentation Contexts to be used on that association. Presentation Contexts are written in tables with, e.g. additional notes.

Example EasyVision: An EasyVision has many different Proposed Presentation Contect table for "Association Initiation Policy" and "Association Acceptance Policy".

- Proposed Presentation Contexts for Copy EasyVision to Other
- Proposed Presentation Contexts for Remote Database Query
- Proposed Presentation Contexts for the Print Request Activity
- Proposed Presentation Contexts for the Printer Status Request
-

Proposed Presentation Context table for the Print Request Activity:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

5.4. COMMUNICATIONS PROFILES

5.4.1. TCP/IP STACK

All implementations shall conform to DICOM V3.0 TCP/IP Network Communication Support as specified in DICOM Part 8.

Example:

The EasyVision application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.
EasyVision inherits its TCP/IP stack from the SUN Solaris system upon which it executes.

5.4.2. PHYSICAL MEDIA SUPPORT

The Media Access and Physical layer protocols shall conform to ANSI (IEEE) 803.2 (Ethernet). The preferred physical medium is unshielded twisted pair (10Base-T).

EasyVision Example:

Ethernet ISO 8802-3. Standard AUI, optional twisted pair 10-BaseT.

DSI Example:

The DSI system supports ISO 8802-3 10BASE5 Ethernet.

5.5. EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

Detailed information on Private SOP Classes, Transfer Syntaxes and Private attributes can be mentioned in this section.

Example:

The Standard DICOM SOP Classes may be Extended with additional attributes:

- Standard attributes of other SOP Classes.
- Retired (from ACR NEMA 1.0 or 2.0) attributes.
- Private attributes.

Example for modality:

A modality creates DICOM standard extended Information Objects in such a way that each image can contain additional private elements stored in private groups. These elements are used to store data not defined in DICOM and are evaluated when re-importing the images via the DICOM Interface.

If these images are modified on DICOM nodes, then these applications are responsible for data consistency. All unknown private attributes have to be removed upon modification!

5.6. CONFIGURATION

How are the DICOM settings to be configured?

Example:

The EasyVision system is configured by means of a configuration program. This program is accessible at start-up of the EasyVision system. It is password protected and intended to be set by Philips service engineers only. The program prompts the service engineer to enter configuration information needed by the EasyVision application.

5.6.1. TITLE/PRESENTATION ADDRESS MAPPING

Local AE Titles and Presentation Addresses

Overview of configuration of local AE titles and addresses.

Example:

The EasyVision AE title is equal to the IP host name. This host name is to be entered by the service engineer at EasyVision configuration time.
EasyVision listens on port 3010. This port number is not configurable.

Remote AE Titles and Presentation Addresses

Overview of configuration of remote AE titles and addresses.

Example:

All remote applications that wish to communicate with EasyVision must be defined at EasyVision configuration time. The service engineer must provide the following information for each remote application:

- The application entity title.
- The IP-address
- The host name on which the application resides.
- The port number at which the application accepts association requests.

For remote applications that act as service class provider the following additional information must be provided:

- The SOP classes for which the application provides conformance as an SCP.

Configurable parameters

Description of configurable items.

Example:

The following items are also configurable:

- automatic conversion of images of SOP classes not supported by remote stations into SC Image Storage SOP instances,
- the maximum PDU size per node,
- export of private (and retired DICOM if present) attributes or not
- validation of incoming images
- ...

5.7. SUPPORT OF EXTENDED CHARACTER SETS

Which Extended Character Sets are supported?

Example:

EasyVision supports Extended Character Set “ISO_IR 100” which is the Latin alphabet No 1, supplementary set.

5.8. APPENDICES

EasyVision Example:

Overview of the applied Service Elements

This section gives an overview of the applied attributes in the applied Service Elements of the supported SOP Classes.

DSI Example:

Overview of the applied Image IODs

Detailed information about:

- the X-Ray Fluoroscopy (XRF) Image IOD
- the Secondary Capture (SC) Image IOD
- the Modality Worklist IOD
- the Study Component IOD